

REMARKS

Claims 1-17 are pending in the application. Claims 3, 7-14 and 17 have been withdrawn from consideration. Claims 1, 15 and 16 have been amended. Favorable reconsideration of the application is respectfully requested.

I. REJECTION OF CLAIMS 1, 2 AND 15 UNDER 35 U.S.C. § 103(a)

Claims 1, 2 and 15 remain rejected under 35 U.S.C. § 103(a) as being unpatentable over Naito et al. (U.S. Patent No. 5,646,953) in view of Takeya et al. (U.S. Patent Application Publication No. 2003/0136970). The Examiner acknowledges that Naito et al. fails to disclose: (1) a second p-type nitride semiconductor layer containing Mg, (2) the first p-type nitride semiconductor layer being located between the active layer and the second p-type nitride semiconductor layer, and (3) the second p-type nitride layer having a greater band gap than a band gap of the first p-type nitride semiconductor layer.

It is the Examiner's position that it would have been obvious based on the teachings of Takeya et al. to have modified the semiconductor device of Naito et al. to include these missing features, as Takeya et al. teaches placing a p-type (Mg-doped) GaAlN electron blocking layer (EBL) so that the waveguide layer is between the EBL and the active layer.

The Examiner states that the EBL would have to have a bandgap larger than that of the waveguide layer for the blocking layer function to occur, and further, that in the semiconductor art it is well known that Mg is typically used as the p-type impurity in GaAlN.

With regard to the method recited in claims 15, the Examiner acknowledges that Naito et al. fails to disclose the specifics of the MOCVD method. Nevertheless, it is the Examiner's position that it would have been obvious to have grown the GaAlN p-doped layers of Naito et al. using the MOCVD method, including using a source gas containing Al and Mg, as taught by Takeya et al.

Applicants respectfully traverse the rejection for at least the following reasons. Claim 1 has been amended to recite the feature *wherein the first p-type nitride semiconductor layer is in contact with the second p-type nitride semiconductor layer*. Claim 15 has been amended to recite the step of *forming the second p-type nitride*

semiconductor layer on the first p-type nitride semiconductor layer. Support for the amendment to claims 1 and 15 can be found, for example, on page 26, line 14 to page 27, line 5 of the present specification and in Figs. 4 and 5.

In the presently claimed invention, the first p-type nitride semiconductor layer contains Al. The reactivity between Mg and Al is very high. When Mg is added to a source gas that contains Al, the Al and Mg immediately react to form a complex, without adhering to the pipes or the inner walls of the reactor, and thus are taken into the crystal (page 36, line 13 to page 37, line 1 of the instant specification). Therefore, by purposely allowing Al to be contained in the first p-type nitride semiconductor layer, the memory effect of Mg doping can be successfully reduced (page 35, lines 8-10 of the instant specification). Thus, the Mg doping concentration of the second p-type nitride semiconductor layer is increased. Such advantage is obtained only when the first p-type nitride semiconductor layer is in contact with the second p-type nitride semiconductor layer.

In the semiconductor device of Takeya et al., the p-type (Mg-doped) GaAlN electron blocking layer 11(p) (EBL 11(p)) is located on the undoped InGaN layer 10 as shown in Figs. 3 and 8.

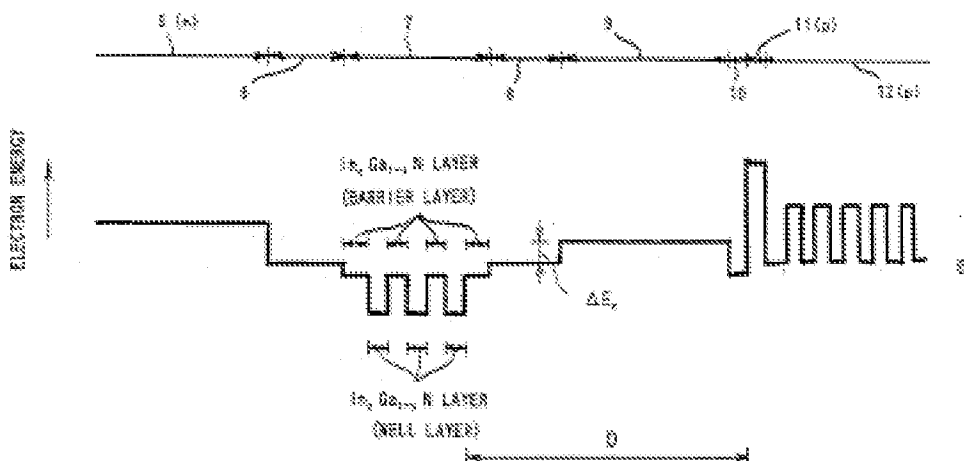


Fig. 3
Takeya et al.

In order to obtain the device of Takeya et al., the EBL 11(p) is grown after the growth of the undoped InGaN layer 10. The undoped InGaN layer 10 does not contain Al. As just described, Takeya et al. teaches that the layer which is grown just before the growth of the EBL 11(p) *does not contain Al*. If a person of ordinary skill in the art at the time of the presently claimed invention modified the semiconductor device of Naito et al. by introducing a second p-type nitride semiconductor layer as taught by Takeya et al., the skilled person would not bring the Al containing waveguide layer 5B of Naito et al. into contact with the EBL 11(p) of Takeya et al. Thus the combined teachings of Naito et al. and Takeya et al. fail to teach all of the recited features of the claimed semiconductor device and production method. Furthermore, neither Naito et al. nor Takeya et al. even recognize the problem of the “memory effect”. Accordingly, prima facie obviousness has not been established, and the rejection of claims 1, 2 and 15 under 35 U.S.C. § 103(a) should be withdrawn.

II. REJECTION OF CLAIMS 4-6 AND 16 UNDER 35 U.S.C. § 103(a)

Claims 4-6 and 16 remain rejected under 35 U.S.C. § 103(a) as being unpatentable over Naito et al. and Takeya et al. and further in view of Okumura (U.S. Patent No. 6,456,640). The Examiner acknowledges that the combined teachings of Naito et al. and Takeya et al. fail to disclose a non-doped third layer between the active layer and the first layer, wherein the third layer contains Al, has a bandgap equal to the first layer, and which bandgap is smaller than the bandgap of the second layer. The Examiner contends that it would have been obvious, based on the teachings of Okumura, to have modified the first p-type layer of Naito et al. by replacing it with a GaAlN layer including a third layer that is non-doped and that is next to the active layer.

Applicants respectfully traverse the rejection for at least the following reasons. As discussed above, the combined teachings of Naito et al. and Takeya et al. fail to teach all of the recited features of the claimed semiconductor device and production method. Because Okumura fails to cure the deficiencies of the combination of Naito et al. and Takeya et al., the rejection of claims 4-6 and 16 under 35 U.S.C. § 103(a) should be withdrawn.

III. CONCLUSION

Accordingly, claims 1, 2, 4-6, 15 and 16 are believed to be allowable and the application is believed to be in condition for allowance. A prompt action to such end is earnestly solicited.

Should the Examiner feel that a telephone interview would be helpful to facilitate favorable prosecution of the above-identified application, the Examiner is invited to contact the undersigned at the telephone number provided below.

Should a petition for an extension of time be necessary for the timely reply to the outstanding Office Action (or if such a petition has been made and an additional extension is necessary), petition is hereby made and the Commissioner is authorized to charge any fees (including additional claim fees) to Deposit Account No. 18-0988.

Respectfully submitted,

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